OPHTHALMOLOGIC PHANTOM SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

The present application s a continuation-in-part of U.S. patent application, Ser. No. 014,434, filed Feb. 13, 1987, now U.S. Pat. No. 4,762,496.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a medical tissue phantom for use in simulating surgical procedures, and more particularly to an ophthalmologic system, wherein a lens tissue phantom and/or a corneal tissue phantom are placed within a structure generally resembling a human eye, which is itself mounted in a simulated human head.

Description of the Prior Art

The human eye and the eyes of vertebrates in general, although distinguished by a variety of evolutionary modifications, share the same basic anatomical pattern. An anterior, transparent portion, the cornea, is the first ocular component traversed by incoming light, and, for those vertebrates living in air, provides the greatest source of refraction towards focusing the light on the sensory portion of the eye. Nearsightedness (myopia), farsightedness (hyperopia), and astigmatism are all visual disabilities caused primarily by corneal curvature problems Inward from the cornea lies the iris, a spongy, circular diaphragm of loose, pigmented connective tissue separating the anterior and posterior chambers. An opening, the pupil, is formed in the center of the iris and enables passage of light energy therethrough. The anterior and posterior chambers are continuous with one another at the pupil, and are filled with a fluid, the aqueous humor. Intraocular pressure created by this fluid normally will maintain the eye in a distended state. A pair of muscles, the dilator and sphincter pupillae, located behind the iris, control the diameter of the pupil and thus the amount of light passing the iris.

Interiorly from the iris, and supported by thin suspensory fibers, termed ciliary zonule, lies the crystalline lens. Surrounded by an elastic capsule, which is attached to the ciliary zonule, the lens is completely cellular, and by altering shape, functions to accommodate or provide ocular adjustments for the sharp focusing of objects viewed at different distances. After passing through the lens, light energy traverses a semisolid, gelatinous vitreous body, and strikes the retina, the anterior, light-sensitive nerve membrane of the eye.

Any clouding or opacity of the eye lens is termed a cataract. The degree of cloudiness can vary markedly in cataractous lenses, and may be the result of many causes, although the majority are associated with aging, (termed senile cataracts). The essential biochemical change in an affected lens is the sclerosis of its protein, with the primary symptom one of progressively blurred vision. Cataracts are presently the leading cause of adult blindness.

Once a lens is sufficiently clouded so as to impair vision, the only treatment for cataracts is surgical removal. As is discussed in U.S. Pat. No. 4,078,564 to Spina, et al., the Egyptians are believed to be the ones to first surgically treat cataract patients by thrusting a rose thorn through the cornea and pushing the cataractous lens into the vitreous of the eye. In the 1880s, another technique was brought to bear on those senile cataracts that had advanced from the dense, hard phase to the "ripe" or soft and runny phase. Such a progression would frequently occur, over time, and when "ripe", incisions through the cornea and the anterior capsule, would permit the soft material to be flushed out. A major drawback of this procedure was the requirement that the patient wait until the cataract became "ripe", a process that might take 10–20 years, with the patient blind during this entire waiting period.

Beginning in the 1930s, a surgical technique known as Intracapsular Cataract Extraction (ICCE) was introduced, wherein the lens and its surrounding capsule are entirely removed from the eye through a large, 12-to-14 mm incision in the eye. Removal of the posterior portion of the lens capsule under the ICCE technique lays bear the vitreous, which, together with the large incision, may necessitate an extended period of post-surgical care. Additionally, with the posterior lens capsule removed, the posterior chamber implant lenses cannot be used. A subsequently developed surgical technique, Extracapsular Cataract Extraction (ECCE) also requires a large incision in the eye, but results in the removal of only the lens and its anterior covering; the posterior lens covering remains in the eye, protecting the vitreous.

The ICCE and ECCE techniques both require the use of large incisions made in the eye to permit the removal of the lens nucleus or the lens nucleus, the cortex, and the lens capsule, en masse. Beginning in 1967, a new surgical technique was described wherein the lens was fragmented into particles or emulsified by an ultrasonically vibrated tip, while still within the eye. The lens, now emulsified, would thereafter be aspirated from the anterior chamber through an incision in the cornea of much smaller chord length. This new technique, termed "Phacoemulsification" (KPE) by its originator, C. Kelman, provides insertion of the ultrasonically-vibrated tip into the eye through an incision of approximately 3 mm, with the vibrating tip thereafter placed against the cataract. The high frequency vibrations are subsequently used to emulsify the cataract.

As initially taught, the KPE procedure required the prolapse or transfer of the cataract's nucleus into the anterior chamber prior to phacoemulsification. Anterior chamber emulsification is not necessarily safer for the eye. Corneal clarity is maintained in substantial part by an endothelial cell layer that pumps water against an osmotic gradient. This cell layer is apparently unable to repair/replace damaged cells by cell division, and thus when cells are damaged, a burden is placed on the remaining healthy cells to expand and migrate to "fill the void". During the course of cataract surgery, by any method, a proportion of endothelial cells is lost/damaged, primarily through direct or indirect operative trauma. Endothelial cell counts have been made, both pre- and post-operatively, and reported cell losses for anterior chamber phacoemulsification is about 34%, while the ICCE and ECCE techniques reduce this cellular loss to approximately 15%.

The large increase in endothelial cell loss, combined with the challenging maneuvers required to obtain nuclear prolapse, has led to the development of posterior chamber phacoemulsification. In this procedure, after removal of the anterior lens capsule, the central portion of the lens is emulsified, in situ, forming a saucerized nucleus. In the more common bimanual technique, a second instrument is inserted into the anterior chamber